3rd Online Science Writing Workshop

This three-month online workshop organised by *Current Science* brought together participants with diverse backgrounds in science, from 13 institutions across the country. The main goal was to develop knowledge, skills and attitudes for scientific writing and reporting.

The participants were asked to set aside five minutes every day to improve their typing and reading speeds. Over the course of the programme, they were taught an appropriate technique for achieving these goals. Doing this over an extended period of time can result in a reading speed of more than 450 words per minute, instead of the present average of about 150. It is also possible to type more than 60 words per minute against the average of about 30 words per minute.

To practice these skills, many interesting topics from daily life or famous paintings were provided as prompts, based on which, initially at least, 100 words needed to be written. After one consistently hit the 100-word mark, it was progressively increased to 200 and 300 words. The goal was to achieve a daily writing capacity of 2500 words. This capacity would enable one to complete writing a Ph.D. thesis or a book within a month.

One session was devoted to discussing the structure of science and how modern science developed out of natural philosophy. Doctors of philosophy need to have some basic understanding of philosophy, including epistemology, aesthetics and ethics. From this lofty perspective, the session proceeded to demonstrate how it is researchers who create science. Science is intersubjective. Concepts are constantly reviewed and revised based on new evidence and results. Therefore, participants could appreciate the importance of publishing results for advancing science.

Questions are the engine of science. The participants were given the task of asking 'why' every day for a month to develop the habit. After a few weeks, they had to formulate research questions.

The session exposed the participants to databases and tools for literature search. Most of these did not exist before the 1990s. The tools are now easily accessible and some are free. In the information age, literature search is a piece of cake.

K. P. Madhu and Gita Madhu encouraged the participants to question everything because scepticism is an important quality of a scientist. It is necessary to read papers critically. To demonstrate the critical spirit, questions were raised. Why is the ozone layer hole prevalent only at the poles? Could climate change be a purely natural phenomenon? Can skewed sex ratio be explained only by female foeticide? The participants indulged in discussions in support of and against the topics. Healthy discussions were eye-opening for many. Through this, the process of doing science was revisited, where evidence is gathered daily and theories are revised.

Reading new research critically is the only way to stay updated and grow in science. The purpose of different sections of a research paper and ways to read a paper were discussed. The participants were introduced to the three pass method of reading a paper: scan the paper, skimming through subheads in materials and methods, results and discussion. Then, read the introduction and identify the problem being tackled and read the discussion and conclusion to identify the solution offered. Finally, read the entire paper critically to identify the strengths and weaknesses of the methods used and the conclusions inferred from the results. This method of reading, pausing, and reflecting is very useful in gaining control on the contents of the paper.

The trainers introduced tools that can help in writing, such as spelling and grammar checks in MS Word, on Google Docs, and sites like QuillBot. Some tools, like SciSpace, could simplify a research article full of jargon to a simpler, easy to understand version. They, however, warned us not to develop too much dependence on these tools and to use artificial intelligence with caution.

Even though Indians place a premium on English, many struggle to speak and write it fluently. The main reason is that they are not immersed enough in the language to internalise the grammar. Participants revisited the structure of the English language and its rules. They created resources to master the language.

Writers need to take effort to reduce the cognitive load on readers. The purpose is to allow readers to easily develop an understanding of the article. An important takeaway from the workshop: by knowing the word, we assume we know the world, but that is not the case. In the act of writing, one must consider the questions that might arise in the mind of the reader; anticipating and answering those questions is therefore crucial.

Participants were trained to consider the function of each paragraph. Creating highs and lows of emotions and variations in the tempo of a text propels the reader from the start to the finish of the text.

The scaffold of every news item, scientific article, or review has elements of storytelling. The structure of fairy tales, plays and films were analysed to extract useful principles for science writing.

The story grows in the telling. As Feynman said, explaining a paper to someone else is useful to fully understand the paper. It is through sharing that we internalise what we learn. The participants narrated the article they had read in a three-act form, keeping it very simple. The focus was only on the essence of the work done, following a pattern: what is the problem, who tackled the problem, when and where, as well as the what, why and how of the materials and methods used. Providing an understanding about the process and materials used to reach the results creates more impact and instils 'scientific temper' in the readers. The participants were also to focus on a target reader to whom the results would be useful.

Yateendra Joshi, among a select few certified editors in India, provided the nitty-gritty of writing, editing, formatting, submitting and publishing scientific articles. He explained the processes and the potential delays between submission and rejection or acceptance after peer review. He suggested methods to make research productive in terms of quality and quantity of publications

For writing a review article, having a crisp and clear topic is necessary. The work should collate and synthesise all kinds of relevant works published recently. A review article is not just a summary of diverse papers. Hence, work must be done to organise the content for a coherent bird's-eye view. A good review article highlights new experimental designs and tools as well as the gaps in scientific understanding.

Sanjay Pai took a session on ethics in doing science and publishing. He pointed out that improper or unethical science leads to irreparable damage and provided examples to demonstrate the power of institutional ethics committees and their role in upholding public safety and the integrity of science.

In the next session, Madhu clarified distinctions between morality, ethics and law. He pointed out that one of the reasons for the higher amount of plagiarism in Indian papers may be due to the difficulties in the use of English language.

There was an interesting session on grant applications and proposal writing. The trainer suggested answering the funder's implicit question: why should we fund you? He stressed the importance of making the proposal easy to read but comprehensive. When asking for funds, it is important to provide all important, relevant and necessary information. The way we organise our proposal and the information provided can make a significant difference to the outcome. Providing a projected timeline of activities and equipment/personnel available or to be procured/hired would show grant reviewers that we have done our homework.

Art and science co-evolve. An appreciation for visual art and music was inculcated during the workshop. Many scientists, including James Clerk Maxwell and Albert Einstein, pursued both art and science. The importance of incorporating quality literature and artistic creations like music and paintings for better thought formation was communicated. The participants also received a daily diet of passages from good quality writings. The style and variety of famous authors helped them develop an understanding of quality in writing.

The principles and essence of the communication of science, or, for that matter, of any information, were conveyed. To improve the quality of information, relate previous knowledge with current context. Collect, prioritise, integrate and highlight all relevant information. Evaluate and examine facts and sources to validate the content. Engage and activate readers with a narrative structure. Research may have benefits to specific sections of the public. Focus on the potential users to elicit action.

The final exercise in the workshop was to choose a research article by Indian researchers, comprehend the background and context of the work, and report it following a well-designed process to clarify the logic behind the methods used by the researchers. As part of the process, the participants were taught to identify the questions tackled by research papers. They had to introduce the researchers behind the work. By re-humanizing science, we remind readers that it is people who create science, stringing together evidence and logic.

The participants worked intensively to convert new research work published by Indian researchers into a research report comprehensible to readers from other disciplines. Following the method, participants wrote and edited their 300-word stories continuously over the week. To ensure easy readability and completeness of the story, the text was edited and re-edited. The KISS (keep it short and simple) rule was practised. During the session, participants learned to apply the rules of the English language and learned the principles of science writing.

Long sentences can be broken into chunks of words where readers naturally pause. Besides bringing out the rhythm and cadence of prose, this strategy makes restructuring a text easier. Besides learning to edit their own writings, the participants had to review the reports by their teammates. The focus in the reviewing activity was on ensuring ease of reading by establishing continuity of ideas. The participants had to help each other to make all reports clear and concise. Only after the report reaches a certain quality is it considered ready for publishing.

In the course of the workshop, the trainers provided regular feedback on how the participants were performing and inquired about any difficulties experienced. They provided effective and easy-to-follow action plans for issues like time management and habit maintenance.

The hurdles to writing with clarity, cohesion and coherence were overcome via multiple cycles of review and editing. Five reports by the participants have been featured on the site, STEAMindiaReports, as output from the workshop. Some participants continued practicing the principles even after the workshop ended.

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